Space Weather Technical Forecast

Issued on Monday, 01 April 2024 at 01:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Activity declining, with decreasing chance of M-flares. Active to G1 Minor Storm intervals expected day 3 (02 Apr) due to arrival CH18/CH19 HSS.

Analysis of Space Weather Activity over past 24 hour

Solar Activity: Activity has been Low with only small C-class flare activity observed. Peak flare was a C4.8 from AR3615 at 31/1418 as it rotated off the Earth-side, however some magnetic looping from this region is still visible in SDO imagery from over the southwest limb. There are four sunspot regions visible on the Earth-side disc, however all are small and simple. The most notable growth was in newly numbered AR3625 near the northwest limb.

No Earth-directed CMEs were observed, with a filament eruption off the northeast assessed as missing.

Solar Wind / Geomagnetic Activity: Fast wind conditions were observed, likely from a combination of CH15/+ and CH13/+. Solar wind speeds measured by ACE/DSCOVR at L1 rose to be slightly elevated to elevated at 480-550 km/s from 31/0100-1230 UTC, then eased briefly to 400-450 by 31/1500UTC, before a further slight enhancement from 31/1800 UTC to peak 500 km/s. Density of the wind remained around average. Total Interplanetary Magnetic Field (IMF), Bt, was briefly Moderate at 13nT at first, but soon eased to Weak to Moderate levels, ranging 5-10nT from 31/0100 UTC. The north-south component, Bz, was initially Moderately negative (southward), at -10 nT but soon rotated to be mainly positive (northward) from 31/0200 UTC, peaking 8nT, with only brief negative interludes to -6nT. Phi angle remained mostly positive (away from the Sun). Geomagnetic activity was mainly Quiet (Kp1-2) but with one Active (Kp4) interval 31/0000-03000 UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES-18 was at background. High energy electron flux (greater than 2MeV) observed at GOES16 was at background. The associated 24-hour fluence remained below Active, with a value of 1.93e6 integrated pfu at 01/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Declining as AR3615 continues to move onto the far-side with no other notable sunspot regions currently on the disc. There is a chance that any significant flares could still be observed from the Earth-side early day 1 (01 Apr), but otherwise Low activity is expected

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs, although this is only moderate confidence with a small chance of a glancing arrival on day 2 (02 April) from a weak CME that left the Sun on 29 Mar. Otherwise current slightly elevated solar winds, due to the fast wind from CH15/+ or CH13/+, are expected to gradually ease day 1-2 (01-02 Apr). The next enhancement, from the combined influence of CH18/- and CH19/- is then expected day 3 (03 Apr) with any enhancement gradually easing from day 4 (04 Apr). Geomagnetic activity is forecast to be mainly Quiet on day 1-2 (01-02 Apr), increasing to be Active with G1 Minor Storm intervals with the fast wind onset day 3 and perhaps early day 4 (03-04 Apr).

Energetic Particles / Solar Radiation: High energy proton flux, as observed by GOES18, is

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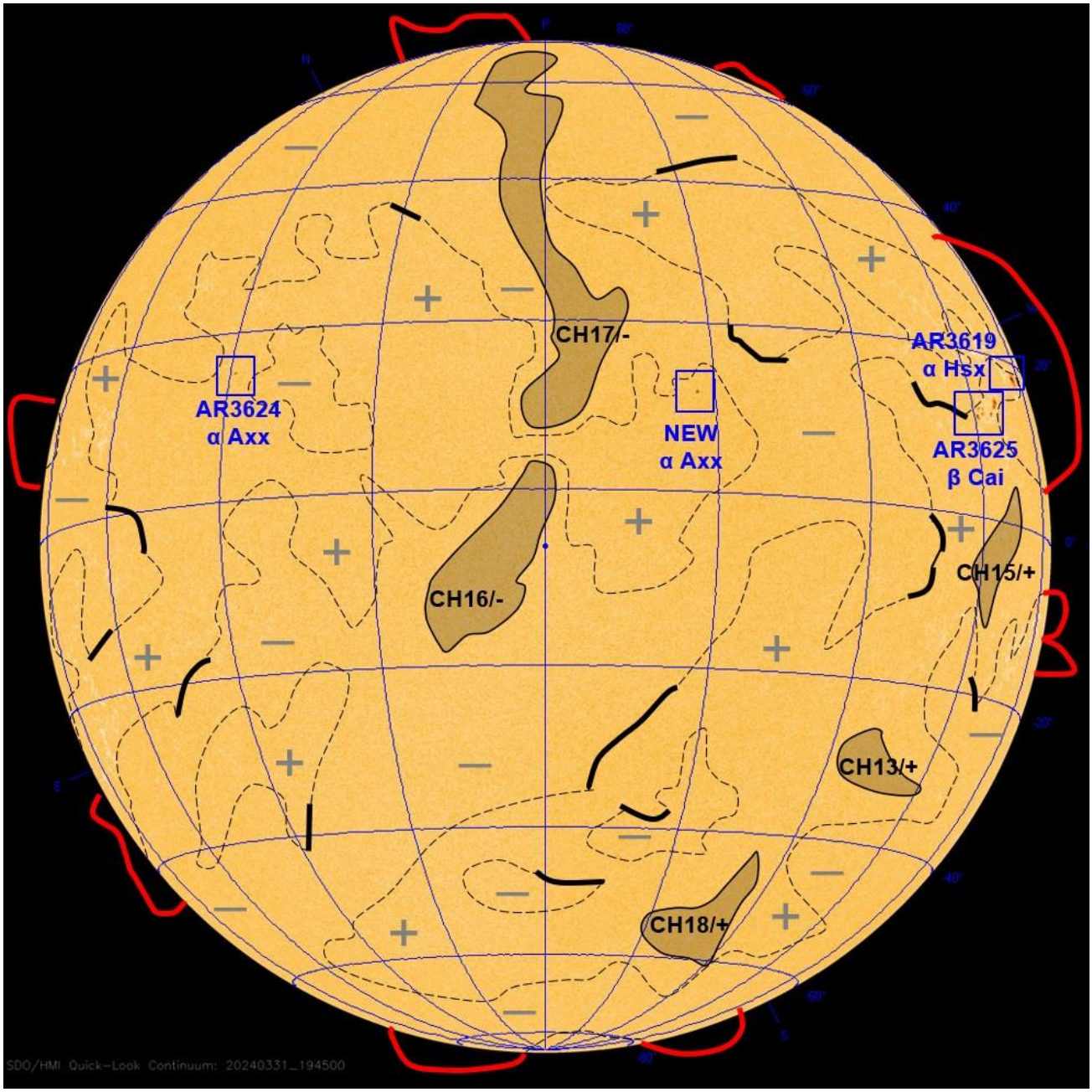
expected to be near background levels, but with a slight chance of enhancement given any strong flares from AR3615 just over the southwest limb. High energy electrons flux is expected persist at Low until the next enhancement on day 3-4 (03-04 Apr), due to the onset of the HSS of CH18/CH19. The associated fluence will persist below the Active threshold, but with a slight chance of rising above by the end day 4 (04 Apr).

Figure 1. Solar Analysis Valid 31/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs, however this is only moderate confidence. This is due to the potential for a very slight glancing interaction from a missing CME which left the southwest disc on 29 Mar, with a weak enhancement possible on day 2 (02 Apr).

Earth is currently seeing fast wind influence from positive polarity CH15/+ and/or CH13/+. These winds are expected to erratically ease day 1 and 2 (01-02 Apr) before the onset of a further coronal hole fast wind from negative polarity CH16/- and CH17/-. These are recurrent features, but much more prominent on this rotation. An earlier arrival is expected, compared to that indicated in either Enlil or 27-day persistence, more likely early on day 3 (03 Apr). Ongoing fast wind effects are then expected into day 4 (04 Apr), before easing later in the day.

Geomagnetic activity is forecast to be mainly Quiet on day 1-2 (01-02 Apr) with a slight chance of Unsettled to Active intervals if any CME arrival is observed. Activity then increasing to be Active with G1 Minor Storm intervals with the fast wind onset day 3 and perhaps early day 4 (03-04 Apr), before easing to Quiet to Unsettled with a chance of Active intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	50	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2a: Solar Wind Persistence Model, showing expected enhancement on 04 Apr

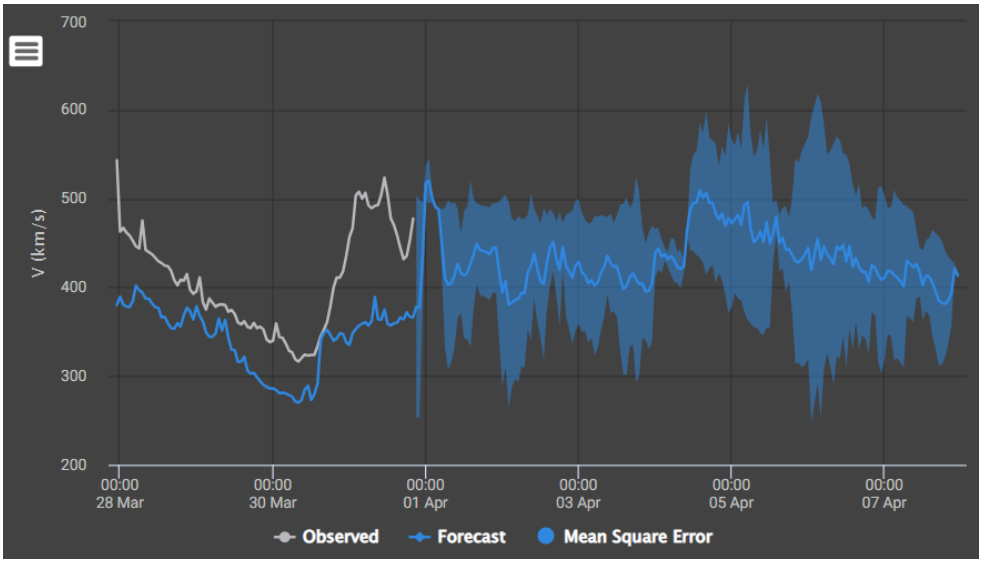

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Figure 2b: SDO aia 211 of last rotation (left) and current (right) showing larger CH on this occasion.

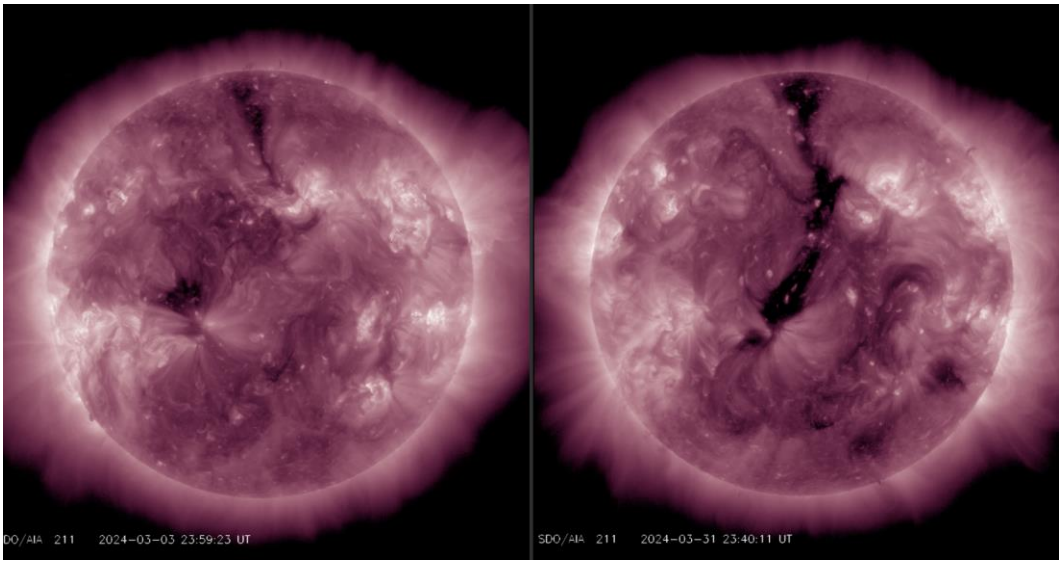
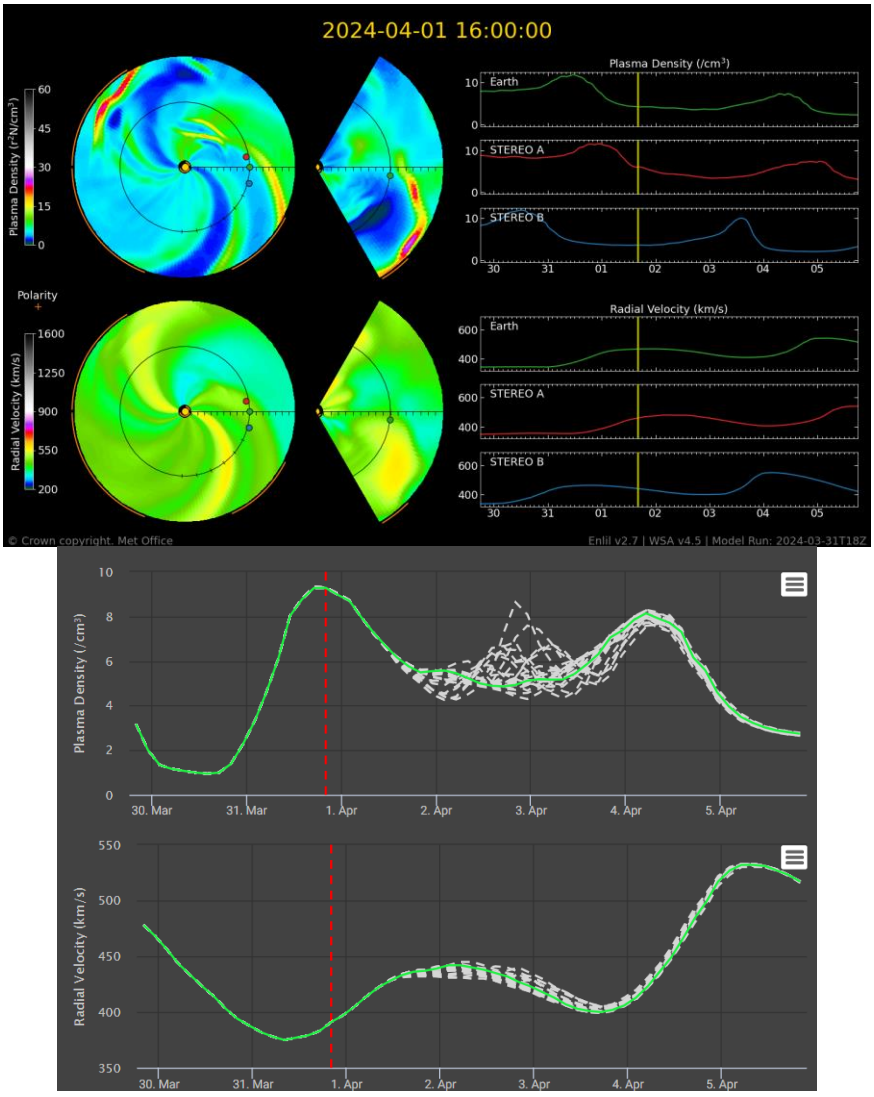


Figure 2c: Enlil with ensemble, showing enhancement late on 03 Apr into 04 Apr, and potential for weak glancing CME.



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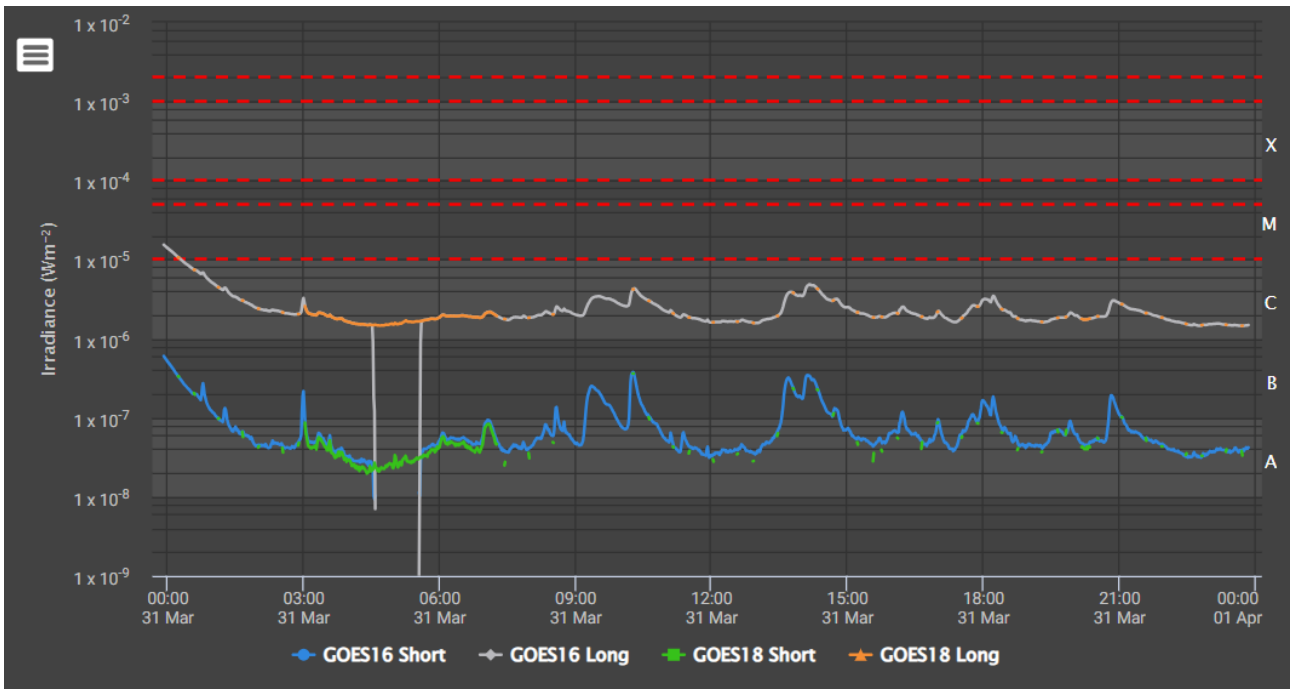
Radio Blackouts - X-Ray Flares:
Low activity expected, with only four small and simple sunspots currently on the Earth-facing disc. There remains a chance on day 1 (01 Apr), albeit declining, for any significant flares from AR3615 to be visible from the Earth-side, with the magnetic looping of the region still visible on SDO imagery.

The only notable recent sunspot development on the Earth-side was the emergence of a small region, AR3625 near the northwest limb. However this remains magnetically simple, and unlikely to produce notable flares.

Ex AR3612, which developed near the northwest limb around 14 days ago, and produced an M-flare as it rotated off, has the has the potential to return onto the northeastern limb by day 3 (03 Apr). There are some indications of magnetic strength in a similar location on far-side helioseismic imagery, however this is low confidence.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	30	10	20	20
Very Active	R3 to R5 X Class	No	5	1	1	1

Figure 3: GOES 16/18 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux observed by GOES-18 is now at background levels, and none of the visible spots are currently expected to produce proton rich flares.

The main risk of any enhancement to the proton flux is from AR3615, which is now over the southwest limb and moving further onto the far-side. Significant flares from this region are still possible, and could still result in protons redirected towards Earth along the Parker Spiral. If such an enhancement was to occur on day 1 or perhaps early day 2 (01-02 Apr), any increase to proton counts could persist for a few days. The likelihood for onset of such an event would is expected to decline day 2 onward (02 Apr).

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	10	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

GOES-16 High energy electron flux at GEO has persisted at background, with no significant enhancements expected until the onset of any fast wind from CH18/19. This is currently forecast to occur on day 3 (03 Apr), with electron count rates likely climbing as a response on day 4 (04 Apr), potentially reaching High by the end of the day.

The associated 24 hour fluence is expected remain steady, well below the Active (1e8 integrated pfu) level, days 1-3 (01-03 Apr), before rising gradually through day 4 (04 Apr). This will bring a slight chance of reaching the Active threshold by the end of the period, but most likely to occur beyond this period. REFM is currently providing a good guide to current conditions until this fast wind onset.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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